MOBILE INSTRUCTIONAL LABORATORY ENVIRONMENTS
AND THEIR USE IN COMPUTING SCIENCES

PANEL DISCUSSION

Stefan A. Robila
Montclair State University, Montclair, NJ
robilas@mail.montclair.edu

Christelle Scharff
Pace University, New York, NY
scharff@pace.edu

Bert G. Wachsmuth
Seton Hall University, South Orange, NJ
wachsmut@shu.edu

Jeffrey L. Popyack
Drexel University, Philadelphia, PA
JPopyack@CS.Drexel.edu

SUMMARY

The term ‘mobile instructional laboratory’ refers to using mobile computing devices such as notebooks for transforming a classroom into a lab setting with the goal of enhancing the practical experience, interaction and understanding. A major goal in all the computing disciplines is to provide students with hands on activities that will enhance their learning of concepts and their professional experience. As such, CS and IT programs require investments in dedicated laboratories that will support applied activities for most of the courses. Unfortunately, space and other resource limitations usually do not allow for permanent creation of such labs. In parallel, current educational philosophy suggests that increased student-student and student-faculty interaction and active learning in the classroom are helpful in increasing students’ understanding of the topics. Consequently instructors are employing techniques that facilitate the interaction and self discovery and rely on technology for support. In both cases, mobile instructional laboratories are a valuable solution.

The way such laboratory is designed and managed depends on the available resources, the nature of the courses and the pedagogical philosophy of the instructors. This panel presents considerations on how faculty from four different institutions view the challenges and benefits of using mobile laboratories for their classes. In each case, the organizational setting differs, ranging from a notebook used for each student group to department/university-wide laptop programs. The labs are mobile from room to room or stationary but highly flexible within the class environment. The devices are either regular notebooks or tablet PCs. The funding for such environments comes from either internal or external sources such as NSF, HP or Microsoft. In all, the panel provides a diverse overview of the
use of mobile technology from institutions in three different states, both private and public, and with varied curriculum.

STEFAN A. ROBILA

While most of the CS and IT courses are well served by a lab component, many of them do not have formal lab modules. Instead, we focus on giving take-home practical assignments or introduce hands on activities in the lectures. Often, the classrooms we teach are traditional ones with ‘minimum technology’ such as computer, projector and wireless network access. In this setting, hands on work would be limited to instructor demonstrations. A notebook cart allows our students to immerse themselves in a lab environment in a regular classroom. They have instant access to classroom resources; they are able to work on practical exercises and interact with each other. In one recent web design class, students installed their own web server and then had peers connected to it to test the correct functioning. In a network security course, students learn how to activate and deactivate system services and how to manage firewalls and then install vulnerability detection tools to test their peers’ configuration.

Mobile laboratories also present challenges, mainly in management. The classrooms need to be easily accessible for the cart or should provide appropriate secure storage. The wireless access points in the area should allow for enough connections to accommodate the entire class. Additional time is spent by the instructor deploying and collecting back the equipment. Reasonable access permissions need to exist on the systems to allow their users to meaningfully use them (i.e. install applications, modify settings) while also trying to ensure that the equipment is available and usable for the next class. This becomes an important aspect when multiple classes share the same lab.

For the last years, laptop carts have been used within the Computer Science department at Montclair State University as mobile labs in a variety of courses including CS II, Operating System Administration, and Web Tools. In May 2006, we received an HP Technology for Teaching grant to encourage the transformation of learning and teaching. We are using the mobile technology to overhaul three IT required core courses that focus on web applications and information security. In these courses students participate in the analysis, design and development of solutions for IT problems. We are revising the course content and topic sequencing and create new examples, assignments and projects based on the tablet PCs’ interactive functionality. The tablets were used in Fall 2006 in one course (Advanced Web Tools, first time offered) and in Spring 2007 in two more (Web Design and Intranet and Internet Security) and we plan on integrating them in additional ones in the coming semesters. Student feedback received supports our approach with most students acknowledging the need for laptops and wireless capabilities.

BERT G. WACHSMUTH

Mobile computing is a great concept, but when it comes to actually using computers in the classroom compatibility problems, differently capable systems, and insulating software often create barriers. In particular, using a laptop in any science class is problematic because of the extensive in-class use of mathematical symbols, diagrams, and sketches, as well as the frequent need to support group work. In my opinion, however, a Tablet PC together with collaborative software with handwriting and presentation support
can be a great tool to enhance teaching and learning and can enable students to participate in a learning environment in more productive ways than traditionally possible. If in general a hardware-software solution is specifically adapted to support teaching in a particular area, mobile computing can be a true asset.

At Seton Hall University we have instituted a “mobile computing program” where all students and faculty receive laptops and we provide extensive support for using technology in and out of the classroom. As “Senior Faculty Fellow” I was involved in piloting Tablet PC’s and special collaborative software, and since last year all Science majors (and faculty) receive Tablets with a standardized suite of software. My students and I have used this technology in several math and computer science classes and found that the quality of the teaching and learning process has increased. To quote one student in a technology-supported Calc 3 course: “It [the collaborative software program DyKnow and Tablet PCs] gave me the time to follow along with the lecture rather than paying more attention actually writing the notes. I was able to pay more attention and thus learn better.”

CHRISTELLE SCHARFF

In 2004, with the support of a Microsoft Research Tablet PC and Computing Curriculum Grant entitled “Toward the Dynamic Classroom: Utilizing the Tablet PC to Enhance Lectures and Team Work Projects at Pace University” we acquired 5 HP 4200 Tablet PCs. They have been used since then in instructors’ lectures and in team work settings (one Tablet PC per team of 3-4 students) in an introduction to computing course for non computing majors taught in a Learning Community setting with an English course, and more recently in the undergraduate software engineering course.

In the introduction to computing course, Tablet PCs were the central pedagogical instrument for classroom communication including instructor’s lectures, faculty-to-student review / feedback, student team work, student-to-student peer review of essays and Web site design options, and students’ presentations with PowerPoint and NetMeeting. Students’ perception of the Tablet PCs effectiveness in the diverse class activities have been gathered in.

Many software engineering activities including requirements gathering, concept generation, design, and document and code review, can be supported more naturally with the Tablet PC, taking advantage of its drawing and handwriting capabilities, providing the ability to directly manipulate and annotate shared artefacts. In the undergraduate software engineering course students used Tablet PCs in class exercises for requirements and design to produce UML use cases and class diagrams. Starting next semester the use of Tablet PCs will be emphasized in the capstone project of that course whose focus, since 2005, has been global software development, where teams of Pace University, Institute of Technology of Cambodia and University of Delhi students work together to develop software products.

JEFFREY POPYACK

We installed our first mobile instructional lab in 2002, as part of Project DUPLEX (Drexel University Programming Learning EXperience). Previously, our labs typically consisted of 25-30 desktop computers arranged in a classroom-style setting, i.e., in rows, all facing toward the front of the room, where the instructor would operate. By moving to
laptop computers, we were no longer constrained to fixed positioning for the student stations, and so designed a lab classroom that could take advantage of their mobility. Our primary goal was to facilitate collaborative learning – and so the “row arrangement” gave way to tables that seat 4-6 students in a semicircular fashion, with one end of the table adjacent to a wall. Each table has its own projector, which can be attached to one of the student machines. Thus, the work on a single machine can be viewed by all students in the cluster. The walls are covered with whiteboard material, so that students may also write on the walls as needed.

In the intervening years, our design has evolved. While our original wish was to keep the machines powered by having spare batteries charging at all times in a separate area, we found that simply having power cables available at the work tables was sufficient. Mobility is not compromised badly by the use of power cables, as the user typically will not need to move about constantly. Another discovery was that mobile projectors are more trouble than they are worth - and so the projectors are now mounted in the ceiling at each work table. While this does preclude spontaneous rearrangements of the room, we have found this more suitable. In the early years, laptops did not have built-in wireless connectivity, and so we tried using wireless cards, direct Ethernet connections, and cards that provided at Ethernet port. Each had its own disadvantages, which disappear when wireless connectivity is built-in.

We now offer all of our freshman courses, for majors and non-majors using our group approach – which exceed the capacity of our mobile classroom. Thus, some labs are conducted in “traditional labs”. The ability for group interaction is clearly diminished in these labs, and certainly workgroups of smaller size are needed. We have since built a second mobile lab. One major difference is the use of flat panel displays rather than projectors for each cluster, which was not an option with our original lab. Another is that as we have invested in newer laptops for our labs, we have chosen larger laptops with big screens, rather than small, lightweight laptops - whereas a lighter laptop is more mobile for someone who travels with it, the more limited mobility needed in a lab allows the tradeoff to the convenience of a larger screen and keyboard.

Our original redesign showed dramatic increases in learning outcomes, which have sustained as we have moved forward. Mobile computing has had a key role in our move to active, collaborative learning.

BIOGRAPHY

Stefan Robila is an Assistant Professor of Computer Science and Director of the Center of Imaging and Optics at Montclair State University. He has received his MS and PhD degrees in computer science from Syracuse University with work on image processing and remote sensing. At Montclair, he has also expanded his work into information security and computer science educations. He is supported by grants from NSF, Hewlett Packerd, Sun Microsystems and SPIE.

Bert G. Wachsmuth, Associate Professor of Mathematics and Computer Science, received his Ph.D. from Indiana University where he worked on mathematical problems in Several Complex Variables. Since joining Seton Hall University he has expanded his research to include the use of technology in teaching, in particular in the sciences. Most
recently as Senior Faculty Fellow for Technology he was instrumental in instituting a "Tablet PC" mobile computing project for all Science students at Seton Hall.

Christelle Scharff is an Associate Professor in the Computer Science Department at Pace University. She teaches databases, software engineering and programming languages. Her research interests are in formal software verification and the use of new technology in teaching. She was awarded grants from NSF, Microsoft and IBM.

Jeffrey Popyack has been the Principal Investigator on three NSF-DUE grants for innovation in teaching computer programming courses. In 1999, he was awarded Drexel’s Undergraduate Teaching Award for Senior Faculty. He is an International Officer of Upsilon Pi Epsilon, the International Honor Society for the Computing and Information Disciplines.